

Separation of Residual Meat Attached to Bones

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As an introduction, I'd like to tell you about STORK, N.V., since many of you may not be familiar with this international corporation. The Stork Group Systems for Meat and Poultry Processing supply a comprehensive range of products to the food processing industry world-wide, supported by a very extensive network of sales and service locations. Nearly all the subsidiaries of the Stork Group Systems for Meat and Poultry Processing take up a leading position in their particular field.

In the meat and poultry industry, which is growing fast world-wide, techniques, technology and production requirements take pride of place. The food processing industry is rapidly developing into an industry with far-reaching automation of production processes, in which (quite apart from productivity requirements) working conditions, hygiene, the environment and flexibility play a crucial role. Product variation and added product value are gaining significance when it comes to meeting consumer demands. The Stork Group Systems for Meat and Poultry Processing is often an important partner in this development who can think along the broad lines of the food processing industry.

The Stork Group Systems for Meat and Poultry Processing consists of several subsidiary companies, each an independent company with its own product development departments, its own product range and its own market approach. Each of the subsidiaries has the in-depth specialization required by the industry today, but joined in such a way that integrated product and market development can be directed in close cooperation from a single group philosophy. The combination of this cooperation and the know-how and experience gained world-wide has resulted in an extremely wide range of production processes and systems for the meat and poultry processing industry.

Separation of Residual Meat from Bone

Separation of meat from bones is a recognized part of good butchery practice, but the traditional manual procedures are time-consuming and labor-intensive. They are also only partially effective, since some of the meat attached to complex bones such as pork, beef or poultry neck bones is difficult to recover by cutting and scraping.

With the advent of centralized deboning in larger plants, it has become possible to use mechanical aids to reduce the

costs and increase the efficiency of the procedures of boning. Various types of machines in the overall deboning activities are available and being used now.

Let us have a closer look at the dividing and deboning area. In the last 15 years, you have seen the introduction of the following machines for the separation of meat:

PAD System (10/11, 400 PC, 200, 800)

These deboning machines are used for primal cuts like pork picnics and legs, turkey necks, lamb shoulders and legs. A primal cut is placed into a pressing chamber where a top and bottom mold are brought together, with the molds having a cavity designed to conform to the shape of the cut being processed. The meat is sheared off the bone and cut off while the bone is caught in the specific cavity.

Grinder bone eliminator

These machines are used widely to grind manual or machine-deboned meat and to separate bone that is inadvertently in the meat.

Meat recovery systems

These machines separate residual meat attached to bones, and are of two types:

1. Press type system
2. Sieve type system

Baader system A

These machines are designed to separate sinews from meat trimmings.

Baader system B

This is a relatively new system designed to separate meat from specific bones like feather bones, button bones and other flat bones.

Proba system

This is a system designed to separate meat from beef neck bones. It is a two-step process, where the meat is first pressed off using a PAD-400 system with a specific mold to accommodate the neck bone, but allowing small pieces of flat bone to come out with the meat. The meat and bone mix then passes through a specific Baader system to remove the flat bone pieces.

Trim MRS-60

A modified MRS system with no filters at the ram and bone slide but slit filters of approximately 4 mm. on the filter rings within the cylinder. With considerably lower pressure, meat can be pressed off, allowing small bone particles to come with the separated meat. The meat is next passed

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Reciprocal Meat Conference Proceedings, Volume 46, 1993.

through a simple filter system to take the remaining bone particles out. Only a few tests have been carried out on this system, but with good results.

Pork head deboning system

A process line to separate the meat from whole pork heads.

As you can see, there are a lot of activities addressing systems to separate lean meat from bone.

Traditional Meat Recovery

Broadly speaking, there are two types of machines on the market that separate residual meat from bones, each applying distinctly different principles:

The sieve-type system (Figure 1)

Crushed or preminced bones are pressed against a fine sieve or screen which allows soft material to pass through but retains the solid bone. Because of the nature of this process, it is more suitable for bones with a very high meat content (e.g. poultry bones).

The press-type system (Figure 2)

The other type of deboning machine is the pressure type, of which Protecon is the most well known, but also includes the Hydrau and Injctstar. The principle used is that of *differential extraction*, a method based on the principle that different grades of solids, like meat and bone, behave like incompressible fluids at very high pressures, with individual flowing properties related to their different viscosities. At these pressures, lean muscle meat starts to flow first, followed later on in the cycle by fat. Some connective tissue also flows with the meat but significant quantities are left with the bone.

System Comparisons

Table 1 provides a comparison between the two different systems. Table 2 provides information on typical yield data from both systems. As you know, the data can differ from case to case depending on deboning procedures and quality of deboning. However, the quality of recovered meat is such that it can serve as an extremely valuable source of replacement protein.

Re-evaluation of "Meat Recovery"

It is my personal opinion that a big mistake has been made in the past by using the word "recovery," since it is my understanding that in the English language, "recovery" has a bad taste. I have been told that it means something like "picking bones out of a bin, taking the dust off, and (surprise!) quality meat results." This of course is nonsense; we are too busy in the food industry to do this.

What I believe should be the approach for the re-evaluation of meat separation is the following:

There should be a positive approach to optimize available meat. As high-cost animals are bred, fed and slaughtered, the industry has a moral duty to use the meat—all of it.

Bones with residual meat should be treated like human food. Many complex regulations are written for this purpose. As a matter of fact, it comes down to treating these bones as you would treat spare ribs or T-bone steaks. If you do so, you will be in good shape to get a quality separated meat product.

Be selective in what bones are to be processed. In the red meat species, I would recommend processing: neck bones, back bones, ribs. No marrow bones should be processed, nor should heads or lower feet.

Go for quality. Take extreme care of the bones selected for processing. Find the right balance between the machine settings and the desired yield (in other words, control the calcium levels and the temperature). Maintain the quality of the meat by effective cooling and/or freezing before further processing.

Meat Recovery Around the World

Meat recovery is an established procedure all over the world today, except in the U.S., where meat recovery is still a grey area.

Stork Protecon alone has some 520 installations running on a daily basis all over the world. I presume that, in total, far more than 1000 systems are running day in and day out. In the poultry industry, there is a preference for rotating sieve machines; whereas in the red meat industry, the preference is for the press type systems.

Most of the installations are running in plants where dividing and deboning takes place, and where further processing is also done, but you also see specialized plants in both the poultry and red meat areas that only process bones.

Regulations on Separated Meat

In the EEC, separated meat is considered to be "fresh meat." Of course, some exceptions are made in terms of bones not to be processed (feet, heads, etc.) To be accepted for the EEC, processing has to take place in an EEC-approved plant, and separated meat should have a heat treatment. Still, some discussions are going on in terms of application in certain products, such as products that have to be cooked before use. In England, separation of meat is done according to the BMMA code of practice.

General Comments

In the early days of meat recovery, there was very little meat left on the bone. The raw material arising from the boning rooms is now so meaty that even reasonably well hand-deboned bones can easily yield up to 15% by further hand

Figure 1
SIEVE TYPE SYSTEM

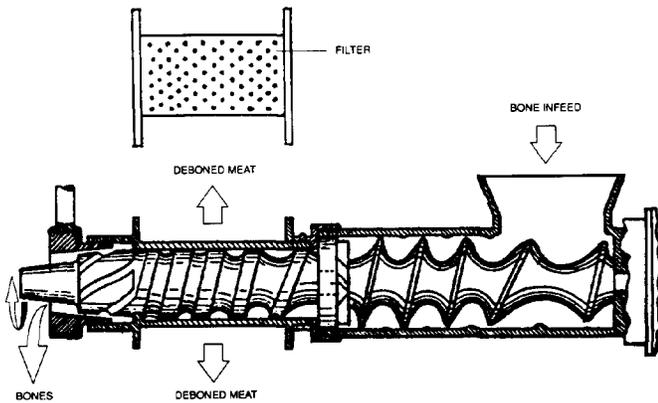


Figure 2
PRESS TYPE SYSTEM

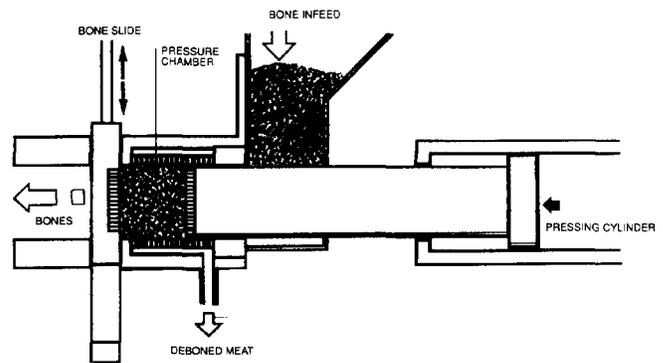


Table 1. Comparison of Press-Type and Sieve-Type Meat Recovery Systems.

<i>Press type</i>	<i>Rotary sieve type</i>
<ul style="list-style-type: none"> - Protecon - Injectstar - Hydrau 	<ul style="list-style-type: none"> - Protecon - Beehive - Yieldmaster - POSS - LIMA - Baader
<i>General Advantages and Disadvantages</i>	
<ul style="list-style-type: none"> - Batch system - Versatile - Capacities from 150 up to 1800 kg/hr. - <i>No pregrinding</i> <ul style="list-style-type: none"> • lower energy costs • lower temperature rise • less oxydation - <i>No rotating parts</i> <ul style="list-style-type: none"> • low maintenance costs • low temperature rise • fast/easy cleaning • no metal contamination - <i>Variable pressure/pressing time</i> <ul style="list-style-type: none"> • accurate quality/yield control 	<ul style="list-style-type: none"> - Continuous system - Separate machines for red meat processing/white meat processing - Capacities from 100 up to 3500-4000 kg.hr. - <i>Pregrinding</i> <ul style="list-style-type: none"> • higher energy costs (up to 60 HP) • increased temperature rise (bacteriological) • intensive contact with air (oxydation - discolouring) - <i>Rotating parts</i> <ul style="list-style-type: none"> • high recurring maintenance costs • increased temperature rise • difficulties in cleaning • increased calcium levels • increased marrow/bone ash contents • risk of metal and bone chips contamination - <i>No pressure/pressing time control</i> <ul style="list-style-type: none"> • decreased control over quality and yield

trimming, an operation which is no longer economically viable to consider. It is the volume of expensive finished cuts going through a boning plant which represents the profit. Whole cuts of meat containing very little bone are often discarded as waste, particularly where automatic cutting is being used (a bandsaw is now a machine deboning unit in many plants).

If meaty bones are handled according to G.M.P., it is my personal opinion that machine-deboned meats yield superior

quality desinewed meat. Like high quality meats prepared for sale, where fat and sinew are hand trimmed, analytical data is going to change because the difference between the primal cut and the finished product for sale is the removal of the connective tissue and fat. Both of these are removed during machine deboning, even with the new generation whole-muscle deboners.

Questions for a number of years have been posed by ana-

Table 2. Typical Yield Data for Press- and Sieve-Type Systems (for several species).

<i>RECOVERED MEAT FROM PIG BONES/PRESS TYPE</i>					
<i>Bone type</i>	<i>Yield x/%</i>	<i>Moisture %</i>	<i>Fat %</i>	<i>Protein %</i>	<i>Calcium %</i>
Pork, shoulder + blade	24	55.7	34.2	9.8	0.07
Pork untrimmed neck bones	49	64.6	17.4	16	0.08
Trimmed neck bones	36	61.4	22.7	15.2	0.09
Trimmed neck bones 50%					
Blade bones 50%	40	63.7	22.9	14.7	0.12
Loin end + rib tips	51	56.2	29	14.2	0.05
Fresh shank bones	17	56.7	33.4	9.7	0.09
Aitch bones	31	61.1	24.6	13.7	0.10
Center ham bones	24	59.2	29.3	10.7	0.09
Fresh ribs	36	58.3	28	14.8	0.07
Neck blades	41	65	18.8	15.6	0.04
Ham bones (shank, leg, aitch)	24	57.3	32.4	10	0.08
<i>RECOVERED MEAT FROM BEEF BONES/PRESS TYPE</i>					
<i>Cattle Bone type</i>	<i>Yield x/%</i>	<i>Moisture %</i>	<i>Fat %</i>	<i>Protein %</i>	<i>Calcium %</i>
Loin + chuck bones	30	58	28	13.5	0.09
Round bones	18	55	32	9	0.10
Shoulder bones	18	55	32	9	0.11
Rib bones	5	56	32	8	0.09
<i>RECOVERED MEAT FROM CHICKEN BONES/PRESS TYPE</i>					
<i>Bone type</i>	<i>Yield x/%</i>	<i>Moisture %</i>	<i>Fat %</i>	<i>Protein %</i>	<i>Calcium %</i>
Chicken backs	75.0	67.8	18.1	14.0	0.05
Necks without skin	71.0	66.0	21.8	11.5	0.03
Mixed necks and backs	84.7	68.0	17.4	13.5	0.06
<i>RECOVERED MEAT FROM CHICKEN/ROTARY SIEVE</i>					
<i>Bone type</i>	<i>Yield x/%</i>	<i>Moisture %</i>	<i>Fat %</i>	<i>Protein %</i>	<i>Calcium %</i>
Necks/carcass 1:3	77	69.5	12.8	15.7	0.12
<i>RECOVERED MEAT FROM TURKEY BONES/PRESS TYPE</i>					
<i>Machine MPD-60 Turkey</i>	<i>Yield x/%</i>	<i>Moisture %</i>	<i>Fat %</i>	<i>Protein %</i>	<i>Calcium %</i>
Carcass	72	62.9	21.2	15.5	0.03
Backs	71	60.7	22.7	14.9	0.05
Breasts	64	67.2	14.1	17.2	0.04
Necks	90	75.8	6.6	16.7	0.06
Carcass + neck	70	69.6	13.8	16	0.05

Figures mentioned above are under influence of operational circumstances such as quality of raw material supply and machine setting.

lysts (who like things in tidy boxes) on what constitutes meat. The answer varies with muscle, cut of meat, age, sex, lean/fat ratios, degree of trim and even the part of the country from which the animal comes.

Mechanical separation and deboning is going to be the way in the future by which costs are controlled in the meat industry, so that the consumer can enjoy value-for-money meat products. Part of this cost control depends upon how the lower

value manufacturing meats are prepared cost effectively.

If, indeed, machine deboning has a desinewing effect and this is the only significant difference between it and whole muscle meat, then it is this difference that must be assessed. It must be recognized that meat deboned by machine, under highly controlled production practices, is high quality meat and nothing but meat.

Discussion

R. Field: I just have two comments for John McCutcheon. You gave the example of the consumer who sees the T-bone steaks and says "Yes, that's meat;" and the consumer who sees the ground beef and says "Yes, that's meat." I would point out that if you run that whole muscle through a sieve and use the same sieve that the mechanically-separated product came through, you would have to tell her "Yes, that's meat." She doesn't usually think of an emulsion as meat. But when you run it through the same thing, whether it's mechanically-separated meat or the boneless T-bone steak, it still looks the same! So you have to tell her "it's meat." She had to be told once upon a time that the T-bone steak was meat — probably when she was one year old.

My other comment (as we re-visit this issue that many of us were concerned with 20 years ago) is that we not get too carried away with the idea that excess iron or calcium above that found in the T-bone steak is bad! There are two nutrients that the American diet is short of. One is iron. The excess iron comes from heme-iron, which is nutritionally beneficial. The other nutrient that we are short of, as is most other countries, is calcium.

The calcium is from bone, very fine particles, which many of our parents were raised on in the form of calcium. That was their supplement in Pabulum and other early baby foods. And some still continue to buy it; they buy bone meal tablets at the health food store. The particles are the same size as are found in the products we have been talking about.

That's why I get a little concerned when we talk about these two minerals that are short in our diet but are both readily available and nutritious, and we say "Well, we can't have those in any excess in meat." So before we totally rule this business out and say that it has to be exactly the same composition as meat, let's remember that the product we're talking about is nutritionally beneficial compared to other products.

J. McCutcheon: Two comments; One, we're facing the issue of what meat is as opposed to whether iron is good, bad or indifferent. It's a question of what is normally expected as a component at those levels by consumers to be meat. That gets to your first question then of telling the consumer that something is meat.

We do have a burden of interpreting this branding; and the question, therefore, is what the consumer usually has judged to be meat. And that's the standard we frequently use. We aren't very successful in always telling consumers what their judgment ought to be. The most recent example, I guess, is how safe we feel irradiation is, and we know how concerned consumers are about irradiation! So the issue there — and I don't disagree with you at all about the fact that the product may very well be meat — is how we are going to convey that message so that the American public also agrees with us. And that is one of the burdens we have to consider.

D. Kropf: I want to make this example. I have a friend who is a hyper-absorber of calcium. I think this is a great product for most of us, but I think somehow that she needs to know a

product's calcium level because she cannot tolerate calcium intake, really at any level; in the water she drinks and the food that she eats. This is a serious problem, because her body makes it into kidney stones. So we must keep this in mind.

J. Marsden: Let me address that quickly. Remember that this all happening in the context of very extensive nutrition labeling requirements that include specific information on calcium level for all meat and poultry products. I think that it's really a whole new ball game that we didn't have 20 years ago when we were addressing this.

J. Carpenter: I want to follow up on Ray Field's comments, and also what was said earlier about what is meat and the recognition of meat. Of course, consumers recognize steak, and they recognize hamburger. I would submit to you that if you take mechanically-separated meat and make a frankfurter out of it, they will immediately recognize that. There is no recognition problem.

R. Ross: I have a question for both Bob Hibbert and John McCutcheon. How can an agency legitimately accept the self-styled consumer advocate opinion as speaking for the consumer since they have no clearly-defined constituency which has given them a mandate?

Hibbert: They can't or they shouldn't. That is a real dilemma that the Department faces. I think John makes a valid point when he says that consumer expectations are part of this; but that potentially gets us on a very slippery slope in a number of ways. First of all, because the point that Bob has made is that those views are generally articulated by specific interests as opposed to the average consumer. Second, if you really bear down on the average consumer, as some of the other gentlemen pointed out, you have to precede all this stuff with some education about how sausages are made, etc. All this gets you into this endless bog of studies on studies, and potentially it becomes an excuse for not doing anything.

Unidentified person: If there is any reason for us to be gunshy, I think this is an issue, Bob. We shouldn't accept our typical in-house consumer advocate as the spokesperson. What I'm asking for is your help and ideas. How would you solve the problem. We've appeared before the courts. The courts have said "That isn't meat, in our opinion." We lost then, and we don't want to lose again. The question is: How can we build a case that doesn't take us into court and have us come back with a judge who has a whole parade of people before him, and he's telling us that isn't meat! We need to build a case before we get to court, and that's what we're searching for.

D. Danielson: For John McCutcheon — I'm curious as to what the definition of finished product is. Is it as consumed, as sold, or as exiting the process?

McCutcheon: Well, I don't want to imply that we have anything as precise as what you are looking for. It probably wouldn't be "as consumed." Probably, by our definition and for these purposes, it would be something that is going out of an official establishment.